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**SOCIETY OF ACTUARIES**  
**Individual Life & Annuities United States – Company/Sponsor Perspective**

# Exam CSP-IU

## MORNING SESSION

**Date:** Friday, May 11, 2007  
**Time:** 8:30 a.m. – 11:45 a.m.

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### INSTRUCTIONS TO CANDIDATES

#### General Instructions

1. This examination has a total of 120 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 60 points).
  - a) The morning session consists of 7 questions numbered 1 through 7.
  - b) The afternoon session consists of 8 questions numbered 8 through 15.

The points for each question are indicated at the beginning of the question.
2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.
3. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.

#### Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.
2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.
3. The answer should be confined to the question as set.
4. When you are asked to calculate, show all your work including any applicable formulas.
5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets since they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate morning or afternoon session for Exam CSP-IU.
6. Be sure your essay answer envelope is signed because if it is not, your examination will not be graded.

**\*\*BEGINNING OF EXAMINATION\*\***  
**INDIVIDUAL LIFE & ANNUITIES UNITED STATES**  
**COMPANY SPONSOR PERSPECTIVE**  
**Morning Session**

- 1.** (4 points) Define the elements of insurance risk under each of the following Federal Reserve risk categories:
- (i) Credit risk
  - (ii) Market risk
  - (iii) Liquidity risk

2. (8 points) You are given the following for a block of permanent life insurance sold in 2006:

	Income Statement Year ending December 31 <sup>st</sup> , 2006
<b>REVENUE</b>	
First-year premium	20.50
Renewal premium	0.00
Net investment income	1.07
Total revenue	21.57
<b>BENEFITS AND EXPENSES</b>	
Claims and surrenders	1.40
Expenses and commission	4.70
Change in reserves	12.30
Total benefits and expenses	18.40
Net income	3.17

	Balance Sheet as at December 31 <sup>st</sup> , 2006
<b>ASSETS</b>	
Invested assets	15.47
Total assets	15.47
<b>LIABILITIES AND CAPITAL</b>	
Policy reserves	12.30
Surplus	3.17
Total liabilities and capital	15.47

Assume the following:

- Net investment rate is 8%
- Investment income is based on mid-year insurance cash flows and average reserves

Your company has secured a reinsurance proposal with the following details:

- Coinsurance with 75% quota share
- First-year premium allowance equals 50% of premium
- Renewal premium allowance equals 15% of premium
- Reinsurance expense of 0.3% of premium

## **2. Continued**

- (a) Outline the benefits and risks to your company of using the proposed reinsurance agreement.
- (b) Construct the financial statements assuming that the proposed reinsurance agreement was effective as of January 1, 2006. Show all work.
- (c) Describe advantages and disadvantages of funds withheld coinsurance.
- (d) Identify the changes to the income statement and balance sheet that would result from changing the proposal to funds withheld coinsurance.

- 3.** (9 points) ABC Insurance Company is evaluating a proposal to offer 1-year indemnity insurance coverage to manufacturers of a new flu vaccine.

You are given the following:

- If the vaccine is successful, ABC will receive 90 million at the end of the year
- If the vaccine is defective, ABC will pay 60 million at the end of the year
- The probability of each outcome is 0.5
- The risk-free rate is 8%

A security has been identified that correlates very highly with the net cash flows of the proposal. The security will pay 4.50 for a favorable outcome or cost 3.00 for an unfavorable outcome. The market price of the security is 0.625.

- (a) Identify the three primary variables in financial economics valuation models.
- (b) ABC has approached the government to request risk compensation in the event that the vaccine is defective. Determine the amount of compensation equivalent to applying a 30% risk-adjusted discount rate in calculating the expected value of the cash flows.
- (c) Identify and explain possible concerns that should be considered when using Monte Carlo simulation for evaluating capital budgeting proposals.

**4.** (12 points) ABC Insurance Company has issued the following variable annuity contract in the U.S.:

- Account value at valuation date: 900 (100% equities)
- Death benefit at valuation date: 1000
- Premium paid to date: 1000
- Net asset charges: 1%
- Valuation rate: 7%
- Attained age: 65
- Sex: Male
- Assumed first-year drop: 14%
- Assumed fund recovery: 14%
- Death benefit guarantee: Maximum of an annual ratchet and 5% rollup
- Duration of contract: 5 years

Year	0	1	2	3	4	5
Surrender charges (% of premium paid)	4%	4%	3%	2%	1%	0%
Mortality rates per thousand	–	17	19	21	23	26
Survival function	1	0.983	0.964	0.944	0.922	0.898

- (a) Calculate the U.S. Statutory reserve for the guaranteed minimum death benefit based on Actuarial Guideline 34. Show all work.
- (b) Describe the theoretical and practical issues in valuing guaranteed benefits that need to be considered in setting valuation assumptions associated with policyholder behavior.
- (c) Propose contract features that could be introduced to limit the level of risk associated with the guaranteed minimum death benefit.

**5.** (9 points) You are given the following:

- A life insurance company, ABC, has issued GIC contracts with a face value of 400,000, a term of 1 year and payment rate of 8%. The customers expect to realize a yield-to-maturity of 9%.
- ABC has issued debt subordinate to the GICs with a face value of 200,000. The debt has a term of 1 year and pays 10% on its face value. The debt holders expect to realize a yield-to-maturity of 16%.
- ABC has purchased partial asset-portfolio insurance with a premium of 25,000 from an unrelated insurance company.
- The risk-free rate is 7%.
- Complete portfolio insurance costs 60,000.

(a) Complete the following accounting and risk-capital balance sheets for ABC.

Accounting Balance Sheet			
Assets		Liabilities and Equity	
Investment portfolio	650,000	GICs	
Asset insurance	25,000	Debt	
		Equity	89,014
Total assets	675,000	Total liabilities and equity	675,000

Risk-capital Balance Sheet			
Assets		Capital	
Investment portfolio	650,000	Cash capital provided by:	
Asset insurance provided by:		Customers	
Equity holders		Debt holders	
Insurance company	25,000	Equity holders	40,654
Debt holders		Risk-capital provided by:	
Customers		Equity holders	
Total assets		Total capital	

Show all work.

(b) Identify the distinguishing features of principal financial firms.

**6.** (10 points) The U.K. life insurance subsidiary of Company ABC, XYZ Life, was put up for sale this year as part of Company ABC's strategy to exit the insurance business. Bank 123 was one of three bidders for the business. If Bank 123 wins the bidding battle, the group plans to use financial engineering to unlock value at XYZ Life. This could include securitizing some of the assets and using derivatives and guarantees to refinance the business.

(a) Describe the analysis behind the real-options classification scheme and categorize this investment opportunity.

(b) You are given the following:

- Required return on debt: 5.6%
- Expected rate of return for the market: 10.8%
- Risk-free rate of return: 2.8%
- Beta of Company ABC's stock: 0.87
- Market value of XYZ Life's debt: 1.8 billion
- Market value of XYZ Life's equity: 4.5 billion

Calculate the weighted average cost of capital for Company ABC using the CAPM approach.

(c) Describe other discount rates that are commonly used to price an acquisition.

(d) You are given the following:

- Solvency reserves to be transferred: 2.4 billion
- Tax reserves to be transferred: 2.2 billion
- Required capital for Bank 123: 118 million
- XYZ Life's embedded value: 420 million
- Pre-tax transaction costs associated with the acquisition: 10 million
- Tax rate: 40%

Calculate the maximum purchase value of XYZ Life.

Show all work.

**7.** (8 points)

- (a) Describe the risk management criteria that rating agencies use to assess a life insurance company's Enterprise Risk Management (ERM) quality.
- (b) A rating agency has expressed concern with respect to the life insurance industry's preparedness for a pandemic.

Explain the ERM process for dealing with the catastrophic risk exposure to a pandemic.

- (c) Describe the shortcomings of using cash flow testing models for asset-liability management (ALM).
- (d) Propose a modeling framework for ALM that will support an "excellent" ERM classification by Standard & Poor's.

**\*\*END OF EXAMINATION\*\***  
**MORNING SESSION**

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**SOCIETY OF ACTUARIES**  
**Individual Life & Annuities United States – Company/Sponsor Perspective**

# Exam CSP-IU

## AFTERNOON SESSION

**Date:** Friday, May 11, 2007

**Time:** 1:30 p.m. – 4:45 p.m.

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### INSTRUCTIONS TO CANDIDATES

#### General Instructions

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**Afternoon Session**

- 8.** (4 points)
- (a) (3 points) Describe the key areas of concern that a company should consider when implementing SOX 404.
  
  - (b) (1 point) Describe the valuation processes that fall under the COSO definition of control and indicate which of these steps are not covered by the SEC definition of control.

**9.** (5 points)

(a) Describe the probabilistic approach and the successive ratios approach for modeling interest rates stochastically.

(b) You are given the following:

Benchmark 90-day rate:	3%
Benchmark 10-year rate:	6%
Volatility factor:	10%
Coefficient of correlation of 90-day rate and 10-year rate:	0.8

The following random numbers form a binomial distribution with  $n = 100$  and  $p = 0.5$ , for period 1:

90-day $X_{100}$ :	35
10-year $X_{100}$ :	80

Use the following approximation to the unit normal distribution:

$$Z_n = \frac{X_n - \frac{1}{2}(n)}{\frac{1}{2}(n)^{\frac{1}{2}}}$$

Calculate the next 90-day rate and 10-year rate using the successive ratios approach.

Show all work.

**10.** (12 points) ABC Life, a stock life insurance company, sells payout annuities. A third-party administrator provides minimal data on the block.

- (a) (3 points) Compare:
- (i) dedicated matching of asset and liability cash flows and
  - (ii) active asset-liability management.
- (b) (3 points) Explain the valuation actuary's responsibilities in this circumstance under Actuarial Standard of Practice No. 23 on data quality.
- (c) (6 points) You are given the following for an annuity in payment status:

	Amount	Policy Year of Payment
Premium	10,000	0
Acquisition costs	190	0
Single benefit payment	10,816	End of 2
Maintenance expenses	0	
Investment rate	6%	
Valuation rates	6%	

Calculate the following with the appropriate GAAP income statement presentation assuming:

- (i) The benefit payment is not conditional on the annuitant's survival

Policy year	Premium	Acquisition Expenses	Policy Benefits	Increase in Let Reserve	Maintenance and Benefit Reserve	Implied DAC	Investment Income	GAAP Profit
0								
1								
2								

- (ii) The benefit payment is conditional on the annuitant's survival

Policy year	Premiums	Acquisition Expenses	Policy Benefits	Investment Income	Increase in Deferred Profit Liability	Increase in Benefit Reserve	Pre-tax GAAP Profit
0							
1							
2							

Show all work.



**12.** (9 points)

- (a) (3 points) Describe each of the following:
- (i) Statutory valuation
  - (ii) U.S. GAAP valuation
  - (iii) Tax reserve valuation
  - (iv) Gross premium valuation
  - (v) Embedded value
- (b) (1 point) Explain the objectives of the following:
- (i) International Accounting Standards
  - (ii) Fair value accounting
- (c) (5 points)
- (i) Identify the primary objectives of SFAS 109, "Accounting for Income Taxes"
  - (ii) You are given the following for an insurance company:
    - Tax rate of 20%
    - No beginning-of-year temporary differences
    - Current-year pre-tax accounting income of 1000
    - Valuation allowance of 0
    - End-of-year temporary differences of:

	Financial Statement Carrying Amount	Tax Basis
GAAP DAC	450	
Tax DAC		300
Reserves	-850	-600

Calculate the current tax expense and the net deferred tax asset, based on SFAS 109.

Show all work.

**13.** (5 points) You are given the following for the first 5 years of a SFAS 97 product:

Year	Estimated Gross Profits (end of year)	Deferrable Acquisition Expenses (beginning of year)
1	1000	2000
2	900	500
3	800	0
4	700	0
5	650	0

Assume:

- Policy anniversary: January 1
- Credited rate: 6%
- Present value of all estimated gross profits at 6%: 5000

- (a) Develop the primary DAC asset for years 1 to 3.
- (b) At the end of year 3, an unrealized gain of 100 is expected. The unrealized gain increases the total present value of expected gross profits at the inception of the contract by 75.

Calculate the shadow DAC adjustment at the end of year 3.

Show all work.

**14.** (10 points) You are given the following information for a 6-year, level-benefit term life insurance product:

- No cash surrender values
- Annual premium is payable at the beginning of the policy year
- Deaths occur only at the end of the policy year
- The valuation discount rate is 0%

Age	Policy Year	Gross Premium per 1000 Face	Valuation Mortality Rate	Survival Probability from Date of Issue to End of Policy Year
50	1	3	0.004000	0.9960
51	2	3	0.004400	0.9916
52	3	3	0.004840	0.9868
53	4	5	0.005324	0.9816
54	5	5	0.005856	0.9758
55	6	7	0.006442	0.9695

- (a) Determine the contract segments according to the Valuation of Life Insurance Policies Model Regulation (Actuarial Guideline XXX).
- (b) Calculate the basic reserve for policy years 3, 4 and 5.
- (c) Explain the determination of deficiency reserves.

Show all work.

**15.** (5 points)

- (a) Describe the drivers of demand for securitization in the life insurance industry.
- (b) Describe the advantages and disadvantages of a risk warehousing model.
- (c) Determine the appropriate category of securitization for each of the following situations:
  - (i) A reinsurance company seeks to achieve continued high growth in its international life and accident reinsurance, but accounting rules require acquisition costs to be written off immediately.
  - (ii) A life insurer is concerned with its mortality exposure to pandemic flu.
  - (iii) A life insurer is domiciled in a country with very conservative statutory valuation assumptions on term life insurance.

Justify your answer.

**\*\*END OF EXAMINATION\*\***  
**AFTERNOON SESSION**